in the air increases, which increases the amount of haze and reduces visibility. Particle plumes of smoke, dust, and/or colored gases that are released to the air can generally be traced to local sources such as industrial facilities or agricultural burning. Regional haze is produced by many widely dispersed sources, reducing visibility over large areas that may include several states.

Regional Haze

Chemical reactions of air pollutants and weather conditions can create fine particles, which can remain in the air for several days and be transported great distances. As a result, fine particles transported from urban and industrial areas may contribute significantly to impaired visibility in places, such as national parks, valued for their scenic views and recreational opportunities.

Sources of regional haze vary from region to region. In the eastern U.S., for example, sulfates from power plants and other large industrial sources play a major role. In the western U.S., nitrates, sulfates, organic matter, soot, and dust emitted by power plants, motor vehicles, petroleum and chemical industrial facilities, wildfires, and forest-management burning, all contribute to reduced visibility.

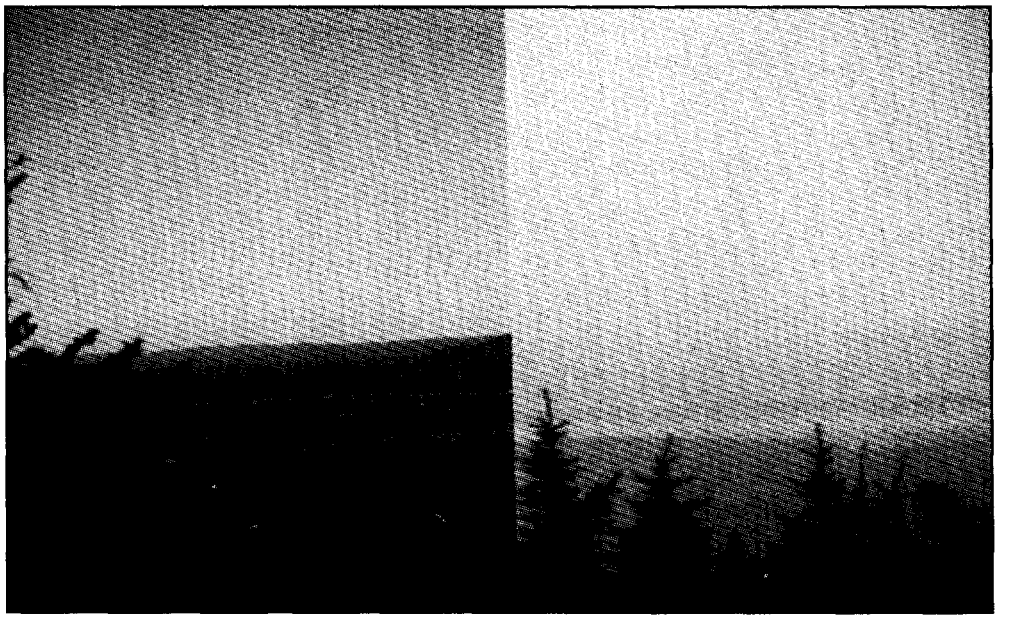
Visibility conditions vary across the country. With a few exceptions, much of the eastern U.S. has poorer visibility than the western U.S. because of higher levels of particles from manmade and natural sources, as well as the effect of higher humidity levels on those particles. Visibility in the eastern U.S. should naturally be about 90 miles, but air pollutants have reduced this range from 14 to 24 miles. In the western U.S., visual range should be approximately 140 miles, while current conditions limit it to 33 to 90 miles. Visibility also varies seasonally and is generally worse during the summer months, when humidity is higher and the air is stagnant.

The Clean Air Act established special goals for visibility in some national parks and wilderness areas. In 1994, EPA began developing a regional haze program that is intended to ensure that continued progress is made toward the national visibility goal of "no manmade impairment." Such control efforts would likely result in improved public health protection and visibility in areas outside national parks as well.

Examples of regional strategies for reducing fine particulate levels include:

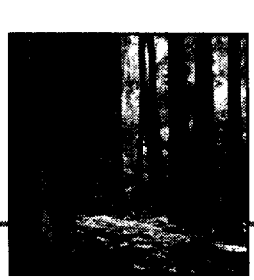
- *reducing particulate emissions by conserving energy and promoting renewable energy sources like solar- and wind-powered energy*
- *controlling SO_2 emissions from power plants and industrial sources*
- *reducing particulate emissions from diesel truck and bus exhaust*
- *reducing controlled burning to manage undergrowth in forested areas.*

EPA's "regional haze" program is intended to ensure continued progress is made toward the national visibility goal of "no manmade impairment."



Visibility impairment in Acadia National Park, Maine.

ACID RAIN



Chesapeake Bay

Chesapeake Bay is the largest estuarine system in the continental U.S. and is home to more than 2,000 species of fish, shellfish, and wildlife. Increasing levels of nitrogen compounds in the Bay are harming this aquatic ecosystem. The influx of higher than normal amounts of nutrients (e.g., nitrogen, phosphorous) allows excessive growth and reproduction of algae, eventually changing aquatic systems by depleting dissolved oxygen and decreasing light penetration to submerged plants.

Recent research concludes that air pollution from power plants is a significant source of nitrogen in the Chesapeake Bay. Studies show that 27 percent of the total nitrogen deposited in the Chesapeake Bay and tidal tributaries is from transport and deposition of air pollutants. Similarly, hundreds of other estuaries such as Puget Sound, Washington and Pamlico Sound, North Carolina, are suffering from effects of excess nitrogen.

The Chesapeake Bay Agreement, a cooperative action among the U.S. EPA, Maryland, Pennsylvania, Virginia, and the District of Columbia, was enacted to reduce and control pollution sources affecting water quality in the Bay. Goals of the agreement are to achieve a 40 percent reduction in nutrients, such as nitrogen, being input to the Bay by the year 2000 and to cap those inputs at 60 percent of 1985 levels. States participating in the agreement are evaluating how reductions in NO_x air emissions will help achieve these goals.

Acid rain is formed when sulfur dioxide (SO_2) and oxides of nitrogen (NO_x) are released into the air. While airborne, SO_2 and NO_x gases and particles contribute to visibility impairment and impact human health. These gaseous compounds react with other substances in the atmosphere to form weak acids and fall to earth as rain, fog, snow, or dry particles. They cause lakes and streams to become acidic and unsuitable for many fish, damage forests, and cause deterioration of cars, buildings, and historical monuments.

SOURCES

By far, power plants burning coal, oil, and natural gas are the primary source of SO_2 emissions. In the U.S., 70 percent of SO_2 emissions come from such plants. Nitrogen oxides are emitted into the air from cars and trucks, coal-burning power plants, and industrial combustion operations such as boilers and heaters.

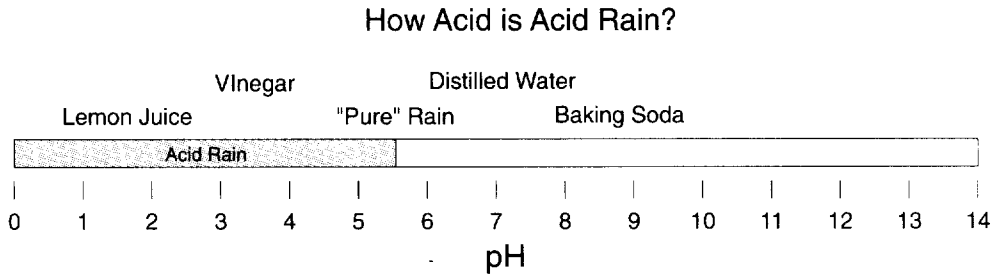
REGIONAL TRANSPORT & ENVIRONMENTAL EFFECTS

In the past, industrial facilities and power plants had shorter smokestacks. When air pollution from these stacks settled in populated areas near the plants and caused sickness, stacks were built much higher. At that time, many believed that if the air pollutants were sent high into the atmosphere, they would no longer be a problem. We now know that emissions released high in the atmosphere can be transported great distances. The Ohio River Valley, where power plants burn high-sulfur coal, leads the U.S. in emissions of SO_2 and NO_x. Consequently, areas receiving the most acid rain are downwind (generally northeast) of the Ohio River Valley. The ecological effects of acid rain depend on both the total amount of acid rain deposited in an area and its soil characteristics. Some soils, such as those generally found in most of the Midwest, contain acid-neutralizing compounds. These areas can be exposed to years of acid deposition without experiencing significant environmental problems. But the thin soils of the northeastern mountains have very little acid-buffering ability, making this area, along with eastern Canada, vulnerable to acid rain damage. Other areas along the Appalachians, as well as certain high elevation western areas, are also sensitive to acid deposition.

Lower pH levels have been found in aquatic systems of the northeastern U.S., indicating higher acidity. These conditions can interrupt reproductive cycles of aquatic plants and animals. Acid deposition can also filter through soils, pick up toxic metals as it passes through, and carry them to lakes and streams, where they accumulate and affect the aquatic food chain.

Statue ruined by acid deposition. Photograph courtesy of the National Park Service.

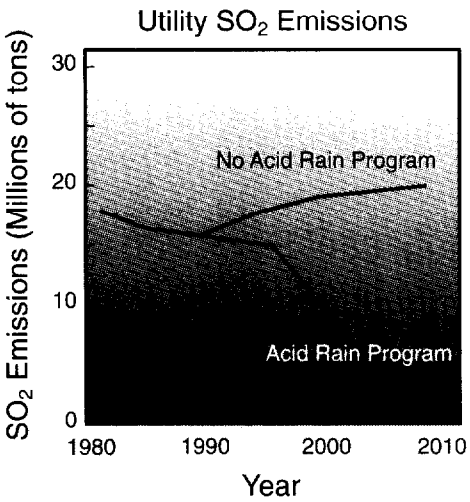
Reducing Acid Rain



The Clean Air Act Amendments of 1990 require major reductions in SO_2 and NO_x emissions and establish a market-based approach to managing emissions of SO_2. Coal-fired electric power plants are the primary target for reducing these pollutants in the U.S. Beginning in 1995 (Phase I), EPA allocated a limited number of "allowances" to 445 electric power plants. These plants can emit up to one ton of SO_2 emissions during a 1-year period for each allowance. Allowances can be bought, sold, or traded among utilities, brokers, or others. Utilities must ensure that their emissions do not exceed the allowances they hold. Pollution control equipment, the use of low-sulfur coal, and implementation of energy-efficient measures such as home insulation programs and energy-efficient lighting are ways power plants can reduce their SO_2 emissions. In the year 2000, Phase II tightens the annual SO_2 emissions on the large high-emitting Phase I plants and sets restrictions on smaller, cleaner plants.

By 2010, EPA's Acid Rain Program and the utility industry expect to achieve a 10 million ton reduction from 1980 SO_2 emission levels.

The Clean Air Act also calls for a 2 million ton reduction in NO_x emissions by the year 2000, a significant portion to be achieved by installation of controls on coal-fired utility plants.

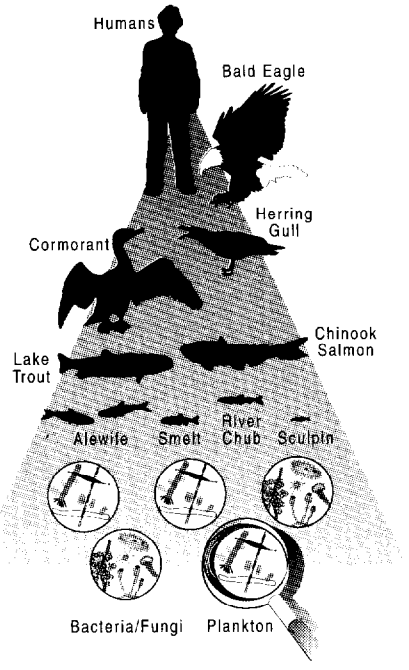


By the year 2010, EPA's Acid Rain Program is expected to reduce SO_2 emissions 10 million tons from 1980 levels.

Although not obvious to the casual observer, many lakes have been affected by acid deposition. Big Rock Lake in the southwestern Adirondacks of New York State has been harmed by acid rain over the last several decades. Fish populations have been severely impacted. (Source: *Adirondack Lakes Survey Corporation Interpretive Report,* 1990. Photograph courtesy of the Adirondack Council.)

TOXIC AIR POLLUTANTS

WITHIN THE NEXT 10 YEARS, THE NATIONAL TOXIC AIR POLLUTANT PROGRAM IS EXPECTED TO LOWER EMISSIONS OF TOXIC POLLUTANTS 75 PERCENT AND THUS REDUCE ADVERSE HUMAN HEALTH AND ECOSYSTEM EFFECTS.



Simplified aquatic food web. *Persistent pollutants do not break down easily in the environment. They accumulate in body tissues and concentrate at each step of the food chain.*

Toxic air pollutants are known to cause or are suspected of causing cancer, adverse reproductive, developmental, and central nervous system effects, and other serious health problems. The Clean Air Act lists 188 toxic air pollutants as hazardous. Examples of toxic air pollutants include heavy metals like mercury and lead, manmade chemicals like polychlorinated biphenyls (PCB), polycyclic organic matter (POM), dioxin and benzene, and pesticides like dichlorodiphenyl-trichloroethane (DDT). Some toxic air pollutants remain in the environment for only short periods of time. These pollutants, including compounds such as formaldehyde, toluene, and benzene, generally impact human health and the environment near emission sources. Other toxic air pollutants, such as lead, mercury, PCB, and DDT, break down slowly, if at all, in the environment and can be redeposited many times. Additionally, they build up in the body and concentrate as they rise through the food chain. Many of these "persistent" pollutants, emitted from various sources including motor vehicles and industrial facilities, are appearing in unexpected locations far away from their sources, including the Great Lakes, Lake Champlain, and the Chesapeake Bay.

REDUCING TOXIC AIR POLLUTANTS

EPA has identified 174 categories of sources that emit one or more of the 188 toxic air pollutants. These sources will be required to reduce emissions over the next 10 years. Since 1990, EPA's toxic air pollutant program has issued a number of rules to control toxic air releases from approximately 50 categories of sources. These include large industrial complexes such as chemical plants, oil refineries, and steel mills and smaller sources such as dry cleaners and commercial sterilizers. One of these rules applies to the organic chemical manufacturing industry, which produces chemicals used in many industrial processes. This rule alone will reduce emissions of toxic air pollutants by over half-a-million tons annually (a 90 percent reduction) and will lower smog-causing VOC by about 1 million tons annually (an 80 percent reduction). Within the next 10 years, EPA's national program is expected to lower emissions of toxic air pollutants 75 percent.

SOURCES

Metals and other toxic air pollutants that persist in the environment and are transported over broad regions come from a variety of sources. Mercury, for example, is a toxic metal that comes from both natural and manmade sources. Coal-fired power plants, municipal waste incinerators, medical waste incinerators, and cement kilns that burn hazardous waste or coal are among the major manmade sources of mercury. Natural sources of atmospheric mercury include gases released from the Earth's crust by geysers, volcanic eruptions, and forest fires. PCB are industrial chemicals used widely in the U.S. from 1929 until 1978 as coolants and lubricants and in electrical equipment. The manufacture of PCB in the U.S. stopped in 1977, and use was restricted in 1979. POM includes a number of cancer-causing products of incomplete combustion and can come from diesel engines and other motor vehicles, wood burning, and industrial burning of fossil fuels. DDT is an insecticide that was widely used in this country from 1946 until 1972. DDT is still used in other countries and, by special permit, in the U.S. Many VOC and fine particulates are also toxic air pollutants. Controlling air concentrations of ozone and particulate matter has the added benefit of reducing toxic air pollutants.

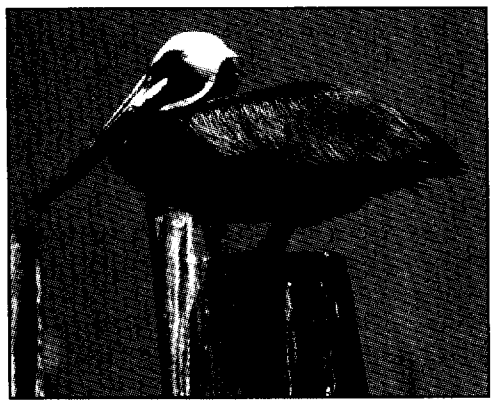
Health & Environmental Effects

At certain levels, toxic air pollutants can cause human health effects ranging from nausea and difficulty in breathing to cancer. Health effects can also include birth defects, serious developmental delays in children, and reduced immunity to disease in adults and children. Toxic air pollutants can also be deposited onto soil or into lakes and streams where they affect ecological systems and can eventually affect human health when consumed in contaminated food, particularly fish.

For example, people who regularly consume fish from the Great Lakes have been found to have higher concentrations of PCB, DDT, and other toxic chemicals in their bodies than people who do not. Fish-eating birds, mammals, and reptiles have experienced a variety of adverse effects associated with chemical pollution.

Long-Range Transport

Scientific studies conducted over the past 30 years consistently indicate that toxic air pollutants can be deposited at locations far from their sources. For example, a number of toxic air pollutants persist in the environment and concentrate through the food web, including toxaphene, a pesticide used primarily in the cotton belt, and have been found in fatty tissues of polar bears and other Arctic animals thousands of miles from any possible source. Lead and other trace metals have been measured in the air and rainfall at remote locations over the Atlantic and Pacific Oceans, great distances from likely sources. Core samples from peat bogs in the Great Lakes region show deposition of new releases of DDT. Since DDT is used only under special conditions in the U.S., this toxic compound may be originating from sources as far away as Mexico or Central America. Fortunately, Mexico has recently banned the use and production of DDT.



TOXIC AIR POLLUTANTS CAN BE DEPOSITED ONTO SOIL OR INTO LAKES AND STREAMS, WHERE THEY AFFECT ECOLOGICAL SYSTEMS AND CAN EVENTUALLY AFFECT HUMAN HEALTH WHEN CONSUMED IN CONTAMINATED FOOD, PARTICULARLY FISH.